

## Clinical Aspects of Vinyl Chloride Disease

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### Acro-osteolysis

The word acro-osteolysis means dissolution of the extremity of a bone and it is applied to the distal phalanges of the hands and feet. There are many causes, e.g. scleroderma, psoriasis, hyperparathyroidism, sarcoidosis, ergotism, diabetes, tabes, syringomyelia, familial and idiopathic acro-osteolysis. A similar appearance may occur as a result of trauma. Recently, acro-osteolysis of the hands of workmen associated with vinyl chloride polymerization processes has been recorded by Cordier *et al.* (1966), Wilson *et al.* (1967), Harris & Adams (1967), Dinman *et al.* (1971), and Lange *et al.* (1974).

We would like to present the radiological findings in four patients who had been involved in the production of polyvinyl chloride.

### Methods

All patients had the following regions examined by plain film radiography: hands, feet, shoulders, elbows, knees, ankles, pelvis, chest, skull, mandible and spine. Case 1 (AD) also underwent a barium swallow, meal and follow-through, angiography of the hands and serial films of the hands at 6 months and 2 years after presentation, and a film of the pelvis at 2 years.

### Case Reports

#### Case 1

A D presented at the age of 35 years with symptoms of severe Raynaud's phenomenon, pain in many joints, trismus, and thickening and tightness of the skin. He had been engaged in the polymerization processes of vinyl chloride for 5½ years. A radiograph of the hands (Fig 1) showed dissolution of the central parts of all the terminal phalanges except for the little fingers, erosion of all the terminal tufts, thinning of the central parts of all the middle phalanges but particularly those of the little fingers where there is extension into the base, thinning of the middle and distal parts of the proximal phalanges of the ring and little fingers and erosions with a well-defined sclerotic margin at the base of the right first metacarpal and at the tips of both ulnar styloid processes. In addition, soft tissue thickening was present over the wrist and the whole of the hand. A film of the feet showed acro-osteolysis of the terminal phalanges of both big toes, a large erosion in the head of the left first metatarsal bone and small erosions in the head of the right first metatarsal bone and the right medial and intermediate cuneiform bones. The radiograph of the pelvis



**Fig 1 Case 1 Hands (1.5.73), showing transverse defects in distal phalanges, osteolysis, erosions and soft tissue thickening**



**Fig 2 Case 1** Mandible, revealing marked erosion of ascending rami

revealed large erosions around both sacroiliac joints, at the tips of the greater trochanters and along both ischial tuberosities. The radiographic survey of the peripheral joints recorded erosions at the lateral end of the left clavicle, left upper humerus, medial and lateral epicondyles of the right humerus, medial condyles of the left humerus, both olecranon processes, inferior parts of the patella, both lateral femoral condyles and anterior aspects of the tibia, both medial malleoli and posterior aspect of the left calcaneum.

Films of the mandible (Fig 2) revealed considerable erosion of both ascending rami, causing marked thinning of the bone; on the left side this extended upwards to involve the condyle.

Films of the skull and spine and barium swallow, meal and follow-through examination showed no abnormalities.

Monitoring films of the hands and feet were taken at six months and 2 years after presentation and these showed interesting changes. At 6 months, the films of the hands recorded the following changes: (a) central defects in the distal phalanges of the little finger; (b) further osteolysis, particularly of the bases of the distal phalanges; (c) periosteal reaction along the proximal phalanges of the left thumb and index finger, and right ring finger; (d) shortening of the distal part of the finger. Radiographs of the hands taken 2 years after presentation showed even further resorption of the bony fragments of the distal phalanges, and the proximal fragments appeared dense thus suggesting avascular necrosis.

Serial films of the feet showed extension of the acro-osteolysis of the big toes in the first 6-month period (Fig 3) but on the 2-year film there appeared to be

some healing as there was new bone formation at the tip of the distal phalanx of the left big toe. However, the erosion at the head of the right first metatarsal bone had progressed in size over the 2-year period. The film of the pelvis two years after presentation showed a slight increase in the size of the erosions of the ischial tuberosities.

In view of the patient's persistent and increasing symptoms and signs in the hands, arteriography of the hands was performed and it was done under general anaesthesia. The large vessels were patent but in the left hand there were occlusions in the digital artery on the ulnar side of the thumb and radial indicis artery of the index finger, and narrowing of the digital artery on the ulnar side of the little finger. In the right hand, slight narrowing and tortuosity of the radial indicis artery and medial digital artery of the little finger was shown. In both hands, hypervascularity of the terminal tufts was recorded.

### Case 2

F P, aged 38 years, had been engaged for two years in the manufacture of polyvinyl chloride. Acro-osteolysis was recorded in both index fingers and the right thumb. Erosions with a well-corticated margin were visualized at the base of the right first metacarpal bone, medial epicondyle of the left humerus and inferior poles of the left patella. Some increase in the soft tissues was noted and this is best assessed by observing the region over the radial and ulnar styloid processes.

### Case 3

D D, aged 28 years, had been involved for 2 years in the processes of polymerization of vinyl chloride. The skeletal survey revealed no evidence of acro-osteolysis or any other significant abnormality.



**Fig 3 Case 1** Feet, six months after presentation

**Case 4**

D W, aged 44 years, had been working at the factory for five years. The skeletal survey did not show acro-osteolysis or any other significant abnormality.

**Discussion**

These 4 cases show the wide radiological spectrum that may be encountered in men complaining of symptoms which could be related to their work in the polymerization of vinyl chloride. In Cases 3 and 4, no specific changes were encountered; in Case 2 only moderate changes were recorded whilst in Case 1, extensive bony changes were documented. Indeed, in Case 1, most regions of the body were involved and a review of the literature revealed that no previously reported case had such extensive bony changes. It has been suggested that personal idiosyncrasy may be an important factor in the wide variation of the radiological findings (Wilson *et al.* 1967).

The changes in the mandible in Case 1 have not been previously described in occupational acro-osteolysis but it is interesting to note that atrophy of the mandible in idiopathic and familial acro-osteolysis has been recorded by Greenberg & Street (1957), Papavasiliou *et al.* (1960), and Cheney (1965).

Ross (1970) stated that the bone changes regress after the sufferer is removed from the hazard but in our Case 1 the serial films of the hands, feet and pelvis indicated that the acro-osteolysis was extending. Fragmentation of the remaining tufts has been described as part of the healing stage by Wilson *et al.* (1967), but in our Case 1 it was only in the distal phalanx of the left big toe that there was any definite evidence on the 2-year film to indicate bony regeneration.

The stenoses and occlusions of the digital arteries and increased vascularity in the pulps of the fingers recorded on the arteriograms in the first case have also been reported by Lange *et al.* (1974). Narrowing and occlusions of the digital arteries are known to occur in Raynaud's phenomenon (Marshall *et al.* 1966). Certainly, the disability due to the Raynaud's phenomenon in our case seemed out of proportion to abnormalities in the vascular tree. Lange *et al.* (1974) suggested that the dense vascular rete of the terminal pulps of the fingers was due to stasis of contrast in the vessels secondary to the shortening of the phalanges. This may be partly the case but Laws *et al.* (1967) have observed hyperæmia of the pulps of the fingers in a case of clubbing due to bronchial carcinoma and a similar mechanism may apply in our case, as there is a strong clinical resemblance to clubbing.

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**DISCUSSION**

**Dr L Magos** said that Dr Preston's Case 1 might be idiopathic acro-osteolysis aggravated by exposure to vinyl chloride. In the two-year follow-up study Dr Preston had found improvement in the fingers, which were usually involved in occupational vinyl chloride acro-osteolysis, and deterioration in the pelvis.

**Dr B J Preston** replied that idiopathic acro-osteolysis was considered in the differential diagnosis of Case 1 but the distribution of the bony abnormalities other than those in the hands was different from those recorded in idiopathic acro-osteolysis.

**Dr K Lloyd Jones** added that Dr Preston's Case 1 also had severe involvement of the skin by the scleroderma-like condition seen in vinyl chloride workers together with evidence of other multisystem involvement. It was most unlikely that this combination in a vinyl chloride production worker (autoclave floor worker) would be due to idiopathic acro-osteolysis. It was not considered reasonable to submit this patient to biopsy of the defects in the distal phalanges. Biopsy of the lesion in the mandible had been unrewarding. He was employed as a production worker in a PVC plant and had never been exposed to vibration or the use of power tools.

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**Clinical Aspects of Vinyl Chloride Disease: Skin**

Industrial acro-osteolysis, a triad of Raynaud's phenomenon, sclerodermatous skin change and lytic bone lesions, has been well documented as occurring in workers engaged in the poly-